Plague

1. DISEASE REPORTING

A. Purpose of Reporting and Surveillance

1. To assist in the diagnosis and treatment of cases.
2. To identify potentially exposed close contacts, health care workers and laboratory personnel and to provide counseling.
3. To identify sources of transmission (e.g., wild rodents or other animals) and to prevent further transmission from such sources.
4. To raise the index of suspicion of a possible bioterrorism event if no natural exposure source is identified.

B. Legal Reporting Requirements

1. Health care providers: **immediately notifiable to local health jurisdiction.**
2. Hospitals: **immediately notifiable to local health jurisdiction**.
3. Laboratories: **immediately notifiable to local health jurisdiction**; specimen submission required.
4. Veterinarians: **immediately notifiable to Washington State Department of Agriculture or to the local health jurisdiction.**
5. Local health jurisdictions: notifiable to Washington State Department of Health (DOH) Communicable Disease Epidemiology Section (CDES) within 7 days of case investigation completion or summary information required within 21 days.

C. Local Health Jurisdiction Investigation Responsibilities

1. **If bioterrorism is suspected, immediately report the case to DOH: 1-877-539-4344.**
2. Facilitate the transport of specimens to PHL for confirmatory testing.
3. Educate potentially exposed persons about signs and symptoms of disease; recommend antibiotic prophylaxis as needed.
4. Report all *suspected, probable* and *confirmed* cases to CDES (see definitions below). Complete the plague report form (http://www.doh.wa.gov/notify/forms/plague.doc) and enter the data in the Public Health Issues Management System (PHIMS).

2. THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Yersinia pestis is a non-spore-forming, Gram-negative, non-motile cocco-bacillus. It exhibits bipolar staining, giving it a characteristic "safety pin" appearance. *Y. pestis* is viable for weeks under moist conditions. However, sunlight and heat readily kill the organism. When released into air, the bacterium may survive for up to one hour, depending on conditions.

B. Description of Illness

The clinical presentation depends on the route of transmission. *Yersinia pestis* infection in humans occurs in one of three primary clinical forms that are discussed below. About 14% (1 in 7) of all plague cases in the United States are fatal.

1. Bubonic Plague

Bubonic plague accounts for over 80% of plague cases in the United States. Patients typically experience a sudden onset of fever, shaking chills, malaise and pain in the lymph nodes closest to the flea bite. Symptoms progress rapidly, with development of lymphadenitis, which becomes very painful. These swollen lymph nodes are known as buboes, which are typically found in the inguinal (groin) region, but also the axillary (armpit) or cervical (neck) region. Untreated bubonic plague can progress to cause septicemia or secondary pneumonic plague. Rarely, it progresses to meningitis.

2. Septicemic Plague

Primary septicemic plague occurs in about 10% of plague cases in the United States. Buboes are not seen in primary septicemic plague, making diagnosis more difficult. Septicemic plague can also occur secondary to bubonic plague. Fever, prostration, myalgia (muscle aches) are common symptoms. Patients may progress to develop endotoxic-shock, disseminated intravascular coagulation (DIC), multiple organ failure (MOF), acute respiratory distress syndrome (ARDS), mental confusion, gangrenous extremities (black plague), and death.

3. Pneumonic Plague

Secondary pneumonic plague can develop in patients with bubonic or septicemic plague. Approximately 12% of plague patients in the United States developed pneumonic plague. Primary pneumonic plague is quite rare: 2% of plague cases in the United States. The death rate for plague pneumonia patients in the United States is approximately 50%. The patient initially exhibits an acute onset of fever, chills, headache, malaise and myalgias, followed within 24 hours by cough with the production of bloody sputum. The pneumonia progresses rapidly, resulting in dyspnea, stridor, and cyanosis, terminating in respiratory failure, circulatory collapse and death.

C. Plague in Washington State

Serologic sampling of 5,957 wild carnivores collected between 1975 and 2006 statewide showed 3.8% reactivity (source: DOH Zoonotic Disease program) indicating that they are feeding on infected wild rodents and that plague is an endemic disease in Washington State. However, human plague infections are extremely rare: the last reported human case was in Yakima County in 1984 in an animal trapper who was exposed while hunting and skinning a bobcat.

D. Vectors and Reservoirs

Wild rodents (especially squirrels, prairie dogs, other burrowing rodents) are the natural reservoir of *Y. pestis.* Feeding fleas transmit the organism, maintaining the disease in the wild rodent population. Infection from the wild reservoir can spill over into other wildlife, domestic animals, and humans.

E. Modes of Transmission

1. Flea Bites

The most common means of transmission to humans is through bites from fleas infected with *Y. pestis*. Fleas become infected by feeding on plague-infected rodents and can remain infective for months.

2. Infected Animals

Handling tissues of infected rodents or other animals is also a source of human infection. Naturally infected cats have been a source of human infection in some instances (natural infection in domestic cats is due to consumption of infected rodents or bites by their fleas). Transmission from an infected cat to humans has resulted from direct contact, bites and scratches, from bites by plague-infected fleas carried by cats, and respiratory droplets from cats with pneumonic plague.

3. Infected Humans

Person-to-person transmission occurs from patients with pneumonic plague through respiratory droplet spread. Individuals with bubonic plague are communicable when buboes or other cutaneous lesions are draining.

4. Intentional Dissemination

Intentional dissemination of plague would most likely occur as an aerosol release of the organism, resulting in pneumonic plague. Individuals who develop pneumonic plague would then be a source of person-to-person transmission.

F. Incubation Period

Generally, the incubation period for plague is 1–7 days with bubonic plaque occurring 2–7 days and pneumonic plague occurring 1–6 days after an exposure.

G. Period of Communicability

Patients with pneumonic plague are communicable at the onset of symptoms, usually within 24 to 48 hours of exposure. The infection generates an intense cough reflex, which readily disperses fine respiratory droplets capable of exposing close contacts. Patients are infectious until completion of at least 48 hours of appropriate antibiotic therapy.

Exudates from buboes contain viable *Y. pestis* organisms and patients with draining buboes are communicable until lesions are surgically excised or heal.

H. Treatment

Treatment includes prompt therapy with appropriate antibiotics and supportive care.

3. CASE DEFINITIONS

A. Clinical Description

Plague is transmitted to humans by fleas or by direct exposure to infected tissues or respiratory droplets; the disease is characterized by fever, chills, headache, malaise, prostration, and leukocytosis that manifests in one or more of the following principal clinical forms:

- Regional lymphadenitis (bubonic plague)
- Septicemia without an evident bubo (septicemic plague)
- Plague pneumonia, resulting from hematogenous spread in bubonic or septicemic cases (secondary pneumonic plague) or inhalation of infectious droplets (primary pneumonic plague)
- Pharyngitis and cervical lymphadenitis resulting from exposure to larger infectious droplets or ingestion of infected tissues (pharyngeal plague)

B. Laboratory Criteria for Diagnosis

1. Presumptive:
   - Elevated serum antibody titer(s) to *Yersinia pestis* fraction 1 (F1) antigen (without documented fourfold or greater change) in a patient with no history of plague vaccination or
   - Detection of F1 antigen in a clinical specimen by fluorescent assay
2. Confirmatory:
   - Isolation of *Y. pestis* from a clinical specimen or
   - Fourfold or greater change in serum antibody titer to *Y. pestis* F1 antigen

C. Case Definition (1996)

1. Suspected: a clinically compatible case without presumptive or confirmatory laboratory results
2. Probable: a clinically compatible case with presumptive laboratory results
3. Confirmed: a clinically compatible case with confirmatory laboratory results

4. DIAGNOSIS AND LABORATORY SERVICES

A. Diagnosis

Y. pestis can be isolated from a variety of bodily fluids and tissues including bubo aspirates and blood. Microbiology laboratory personnel should be alerted when *Y. pestis* is suspected, as laboratory acquired cases of plague have been reported. **Confirmatory laboratory testing must be performed by a reference laboratory such as the Washington State Public Health Laboratories (PHL).**

If the organism is not detected in clinical specimens, serologic testing can be used to diagnose plague.

B. Tests Available at the Washington State Department of Health Public Health Laboratories (PHL)

PHL provides identification of *Y. pestis* from pure isolates as well as culturing of clinical specimens. Serologic tests are not performed at PHL but will be forwarded to the CDC for testing. PHL also performs rapid diagnostic testing in suspected bioterrorism situations. Contact CDES for approval prior to collection and shipment of specimens.

C. Specimen Collection

Consult CDES prior to specimen preparation and shipment.

Culture: Specimens should be submitted by clinical laboratory with a completed PHL Reference Bacteriology Examinations form (http://www.doh.wa.gov/EHSPHL/PHL/Forms/ReferenceBacteriology.pdf). Be sure to follow appropriate shipping procedures.

Serology: One serum specimen should be taken as early in the illness as possible and a second sample 1 to 4 months after antibiotic therapy has ceased. Specimens should be refrigerated and transported cold. Avoid repeated freeze-thaw cycles. Specimens should be submitted by the clinical laboratory with a completed PHL serology Examinations form (http://www.doh.wa.gov/EHSPHL/PHL/Forms/Serology.pdf).

5. ROUTINE CASE INVESTIGATION

Interview the case or others who may be able to provide pertinent information.

A. Evaluate the Diagnosis

Review the clinical presentation and laboratory results. **Confirmatory laboratory testing should be performed by a reference laboratory such as PHL.** Facilitate submission of laboratory specimens to PHL for confirmation. Proceed with investigation after preliminary or confirmatory laboratory results are available for sporadic cases. During an outbreak event or a potential bioterrorism situation, start investigation before laboratory results are available if needed.

B. Identify Potential Sources of Infection

Review clinical presentation and history to determine appropriate potential exposures (i.e., bubonic presentation would indicate most likely flea bite or animal carcass exposure; pneumonic presentation would indicate inhalation exposure). Investigate possible exposures during the period 1 to 7 days before onset, including a history of:

1. Travel to plague endemic areas (e.g., New Mexico, Arizona, Colorado, California);
2. Bites by fleas;
3. Contact with wild or commensal rodents;
4. Direct contact with a "sick" cat (holding, petting, being bitten or scratched);
5. Contact with individuals with confirmed, probable or suspected pneumonic plague;
6. Work in laboratory.

C. Identify Close Contacts or Others Potentially Exposed to the Patient

1. Identify persons having household, hospital or other close contact with pneumonic plague cases and educate them of symptoms of illness to facilitate diagnosis. See Section 6B for recommendations for prophylactic antibiotics.
2. Identify laboratory workers and health care providers exposed to specimens or laboratory isolates and educate them of symptoms of illness to facilitate diagnosis. See Section 6B for recommendations for prophylactic antibiotics.

D. Identify Potentially Exposed Persons

1. Identify and contact persons who participated with the case in any of the activities listed above. If any are ill, inform them (or their physician) of possible exposure, in order to facilitate proper diagnosis and therapy.

E. Environmental Evaluation

1. If the source of infection appears to be wild rodents, the public should be informed of the risk of and how to avoid contact with potentially plague infected rodent populations.
2. If the source appears to be contact with plague-infected commensal rodents or domestic cats, it can be assumed that this is due to spill over from a wild rodent population, and further investigation of the animal source is warranted.

6. CONTROLLING FURTHER SPREAD

A. Infection Control Recommendations

1. Pneumonic plague: Droplet precautions are indicated for all patients until at least 48 hours after appropriate therapy has been initiated.
2. Bubonic plague: Hospitalized patients should be cared for using standard precautions.

B. Contact Management

Persons having household, hospital or other close contact with pneumonic plague cases should receive post-exposure antibiotic prophylaxis and be monitored for fever and cough for 7 days. For additional information regarding prophylaxis, see: http://www.cdc.gov/ncidod/dvbid/plague/prevent.htm.

Guidelines for post-exposure prophylaxis after a bioterrorism attack are outlined in Inglesby TV, Dennis DT, Henderson DA, et al. Plague as a biological weapon: Medical and public health management. JAMA. 2000;283;2281–90.

7. MANAGING SPECIAL SITUATIONS

A. Bioterrorist Event

Yersinia pestis has been classified as a "category A" agent (of greatest concern) for bioterrorism because it can be easily disseminated by aerosol, can be transmitted from person to person (pneumonic plague) and has the capacity to cause severe illness and death. An intentional release (bioterrorist event) should be suspected if unusual clusters of pneumonia are seen in otherwise healthy individuals or in people in buildings with common ventilation systems. **Call CDES immediately if plague is suspected.**

In the setting of a biological attack, antibiotic prophylaxis may be recommended for those with a suspected or known exposure to *Y. pestis*, as determined by public health officials.

For more information, please see Recommendations of the Working Group on Civilian Biodefense, JAMA. 2000;283;2281-2290

8. ROUTINE PREVENTION

A. Immunization Recommendations

There is currently no vaccine available against plague in the United States.

B. Prevention Recommendations

1. **Avoid contact with sick or dead wild animals.** If you hunt, wear gloves when handling dead animals. When skinning wild game keep gloves away from eyes and other mucous membranes. Thoroughly wash hands after handling wild game carcasses. Wild game meat should be cooked "well done" (to at least 74°C/165°F).
2. **Rodent-proof your home.** Eliminate sources of food and nesting places for rodents around homes, work places, and recreation areas; remove brush, rock piles, junk, cluttered firewood, and potential-food supplies, such as pet and wild animal food.
3. **Prevent your pets from contracting fleas.** Use flea-control products and don't allow pets to wander unsupervised. Ask your veterinarian for recommended flea-control brands and guidelines.
4. **Take precautions when outdoors.** Closely supervise your children and pets when spending time outside in areas with large rodent populations. Use insect repellent on your skin and clothing.
5. **If you have symptoms, consult a health care provider as soon as possible.**

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UPDATES